# Climate Conditions in a Livestock Building in Molise: Experimental and Numerical Analysis

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**Abstract**
**Climate control in livestock buildings has a key influence on the productivity and health but it is also a difficult and complex task as the bred animals considerably affects temperature and humidity conditions inside the cowshed.**
**Inaccurate knowledge of the ventilation rates is the major cause of production losses and ventilation-related health problems in modern cattle breeding.**
**Main aim of the present research was the study of the influence of the forced and natural air ventilation on mixing performance in a livestock located in Molise-Italy. Climate conditions were evaluated by mean of temperature distribution in space and time and carbon dioxide in two given points in the livestock building**.

**Keywords:** livestock, ventilation, control

## Introduction

Climate control in livestock buildings is very important for farm productivity and animal health but it is difficult and complex to know how much do the bred animals affect the temperature and the humidity inside the cowshed. Currently in Italy there are still many areas where the breeding takes part in family managed structures and with a limited number of animals. It is exactly in these productive environments that the control of micro-climatic aspects of the shelters is necessary to guarantee a healthy environment for the animals and for the employees.
Ventilation and temperature control in the livestock buildings is usually attained by applying the conventional staged ventilation systems to keep the internal environment according to desired conditions; anyway the livestock farmer may not be able to satisfy the various requirements for cattle products or to meet increasingly stringent regulations on farming methods to decrease the environmental impact or provide a higher standard of animal welfare.
Inaccurate knowledge of the ventilation rates is a major cause of production losses and ventilation-related health problems in modern cattle breeding.
The goal of the present research was a study on the effect of the forced and natural air ventilation in a livestock located in Molise-Italy.

## Materials and Methods

Climate conditions were evaluated by means of temperature distribution in space and time and carbon dioxide concentration in two given points in a livestock building in Molise (Italy). The farm is located in Sepino (CB) and was built in the 80's Years. The used housing is the stall one with short seat and with a head to head disposition. The shelter is connected to service and deposit structures. The refuge has an area of 260 $m^2$, the external walls has been realized by cement face bricks with 2 air spaces. The roof is made by two undulated cement

asbestos boards with a glass wool sheets cavity, and it is supported by purlins and iron beams. The group was composed by 12 cows (average weight 600Kg/head) and 18 calves (average weight 325kg/head).
Measurements were performed using a multi-channels data logger equipped with resistance temperature sensors for its distribution in a half side of the whole space of the tested livestock building and two temperature-$CO_2$ sensors located in the centre and in a low air-mixing zone of the building.
The micro-climatic analysis inside the breeding has been developed by mean of a data acquisition and processing system during a three months period. For temperature acquisition the Lastem Babuc ABC was used equipped with 24 thermo-resistors located in 8 horizontal positions and vertically arranged in groups of three (Fig. 1). Moreover Onset Hobo located in two other points and equipped with the Telaire $CO_2$ detector were used to acquire both temperature and carbon dioxide concentration
We have detected the data during:

- forced and natural ventilation since 05/11/2009 to 11/11/2009;
- natural ventilation since 31/12/2009 to 07/01/2010;
- natural ventilation with translated Hobo since 21/01/2010 to 29/01/2010.

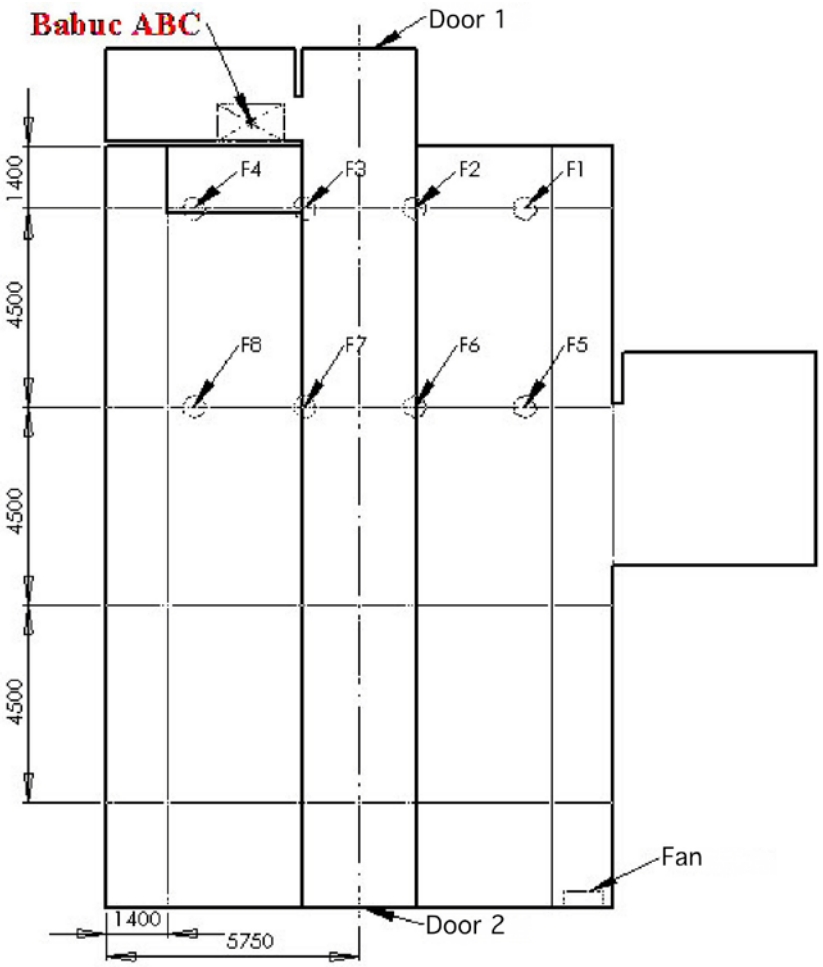


**Figure 1. Shelter plan with temperature sensor and $CO_2$ detector locations.**

**Results**

Measurement results are showed in terms of a temperature distribution graph (Fig. 2) in different ventilation conditions pointing out space-time variations. These data are then related to $CO_2$ measurements in order to highlight not so good air mixing and renewing affecting wellness of animals housed inside.

The forced ventilation system was automatically activated if the temperature went under the 22°C. The temperature was detected by a thermostat located near the central Hobo. The higher early-morning temperature is due to the closed doors during night time that don't allow the air change in the breeding, while the minimum temperature is due to the opened doors for the foods load and unloading.

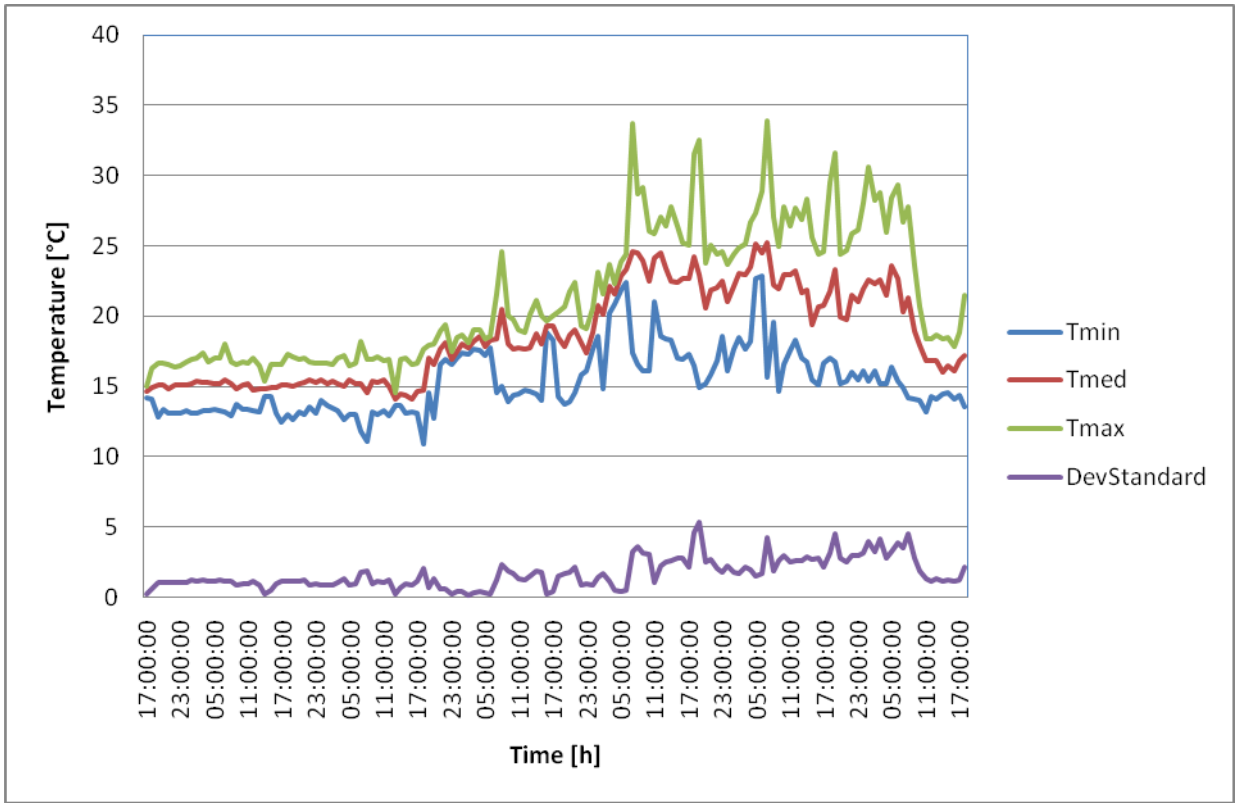


**Figure 2. Temperature in position F7.**

Figure 2 shows the temperature inside the breeding detected by the data logger Babuc in position F7: sampling time was 1s and minimum, mean and maximum values are calculated during one minute and over the group of three thermo-resistors for each plotted value. During the first three days an almost constant temperature can be observed as forced ventilation was used, then very large variations occur as the ventilation system was stopped due to technical problems in fan equipments.

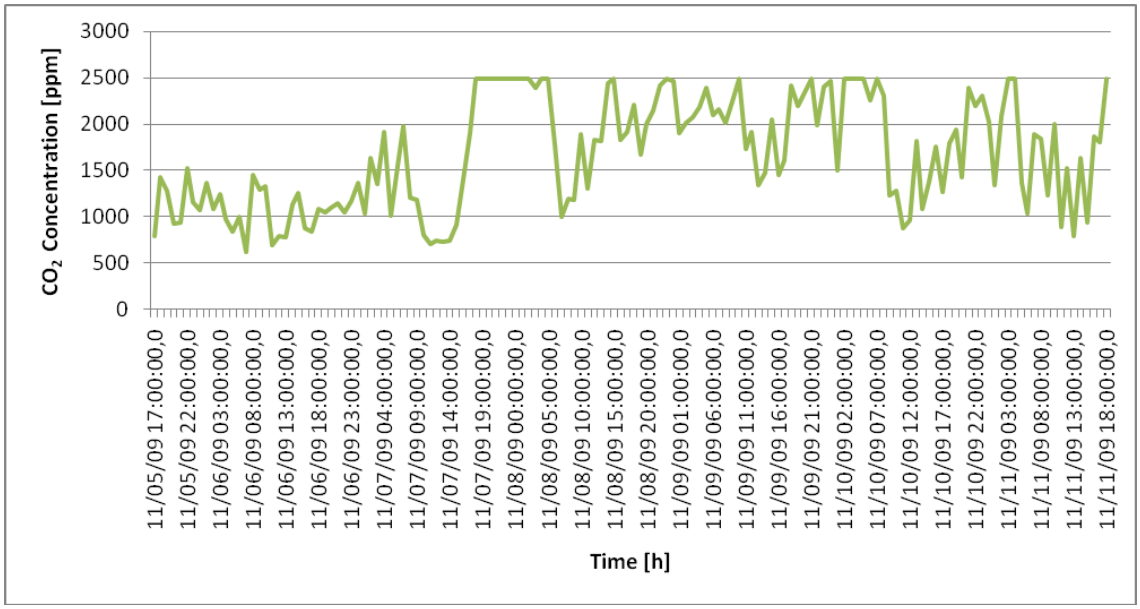


**Figure 3. Carbon dioxide concentrations (Lateral position).**

Fig. 3 shows the carbon dioxide concentration trend. It is clear that during the forced ventilation period (first three days), the values never exceed 2485 ppm which is the storing limit of the Onset Hobo.
Greatest values (2485 ppm ) can be observed after milking (20:00) and in the first hours of the morning (7:00) and in both cases only during the turning off fan period. This could even mean that the maximum level allowed for animals health is likely to be exceeded in these conditions

**Conclusions**

The work carried out give us the possibility to get information related to the trend of some parameters helping to determinate the assess of animals breeding conditions. By the analysis of environmental parameters is possible to assert that with forced ventilation, during the autumn, the variability of inside temperatures is very low and their stratification in plant is homogeneous.
At the opposite during the natural ventilation, in the autumn season, the inside temperature is higher with differences of over 5°C.
These data could be also useful to add more information on animal welfare and beef traceability. Continuous monitoring of micro-environmental parameters could be a tool used by the breeders to improve cowshed management.

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